

What is claimed is:

1. A method for scheduling a plurality of virtual machines comprising:
determining a respective resource requirement (X_i) for each virtual machine (VM);
determining a respective interrupt period (Y_i) for each VM; and
scheduling said plurality of VMs based, at least in part, on said respective X_i and Y_i
values.
2. The method of claim 1 wherein, determining said respective X_i and Y_i comprises
communicating said respective X_i and Y_i from an operating system (OS) running within said
respective VM.
3. The method of claim 1 wherein, determining said X_i and said Y_i comprises
communicating said X_i and said Y_i from an application running within an operating system (OS)
running within said respective VM.
4. The method of claim 3 further comprising:
dynamically maintaining values for said X_i and said Y_i , wherein said application is a
resource management application.
5. The method of claim 1 wherein, determining said X_i comprises communicating said X_i
from an operating system (OS) running within said respective VM.
6. The method of claim 5 wherein, determining said X_i comprises communicating said X_i
from an application running within an operating system (OS) running within said respective VM.
7. The method of claim 6, wherein said application is a resource management application,
which dynamically maintains said respective X_i .

1 8. The method of claim 1, wherein determining a respective X_i comprises:
2 monitoring whether a VM reaches an idle loop;
3 increasing said respective X_i if said idle loop is not reached;
4 decreasing said respective X_i if said idle loop is reached before a predetermined
5 percentage of said resource requirement has been utilized.

1 9. The method of claim 8, wherein determining respective Y_i values comprises:
2 filtering non-periodic interrupts;
3 rejecting aperiodic interrupts;
4 estimating said respective Y_i values for periodic interrupts; and
5 converging said respective Y_i values to be substantially equivalent to actual periods for
6 said periodic interrupts.

1 10. An article comprising: a storage medium having stored thereon instructions that, when
2 executed, result in a computing platform having the capability to:
3 schedule a plurality of virtual machines (VMs) implemented in said computing platform
4 based, at least in part, on a respective resource requirement (X_i) and an a respective interrupt
5 period (Y_i) for each VM of said plurality.

1 11. The article of claim 10, wherein said instructions, when executed result in the capability
2 to communicate said respective X_i from an application running within a VM of said plurality.

1 12. The article of claim 11, wherein said instructions, when executed result in the capability
2 to communicate said respective Y_i from an application running within a VM of said plurality.

1 13. The article of claim 10, wherein said instructions, when executed result in the capability
2 to communicate said respective X_i and said respective Y_i from an operating system running
3 within a VM of said plurality.

1 14. The article of claim 10, wherein said instructions, when executed result in the capability
2 to communicate said respective X_i and said respective Y_i from a resource management
3 application running within a VM of said plurality.

1 15. The article of claim 10, wherein said instructions, when executed result in the capability
2 to determine said respective Y_i by comparing an expected interrupt period with an actual
3 interrupt period and adjusting said respective Y_i based, at least in part, on said comparison.

1 16. The article of claim 10, wherein said instructions, when executed result in the capability
2 to determine said respective X_i by detecting the occurrence of an idle loop within a VM of said
3 plurality and adjusting X_i based, at least in part, on whether said idle loop occurs.

1 17. A method for determining interrupt period values comprising:
2 initializing said interrupt period values;
3 generating virtualized interrupts by virtualizing hardware interrupts;
4 filtering non-period interrupts;
5 rejecting aperiodic interrupts; and
6 adjusting said interrupt period values iteratively until substantially equivalent to actual
7 interrupt periods.

1 18. The method of claim 17, further comprising:
2 acquiring resource requirement values; and
3 scheduling a plurality of virtual machines (VMs) to achieve real-time deadlines based, at
4 least in part, on said interrupt period values and resource requirement values.

1 19. The method of claim 18, wherein said resource requirement values are acquired from
2 said plurality of VMs.

1 20. The method of claim 17, further comprising determining resource requirement values,
2 wherein determining said resource requirement values comprises:
3 initializing said resource requirement values; and
4 adjusting said resource requirement values iteratively based, at least in part, on a
5 determination of an occurrence of a respective predetermined instruction.

1 21. The method of claim 20, wherein adjusting said resource requirement values comprises:
2 increasing said resource requirement values if said respective predetermined instruction
3 does not occur;
4 decreasing said resource requirement values if said respective predetermined instruction
5 occurs prior to a target time; and
6 scheduling a plurality of virtual machines (VMs) based, at least in part, on said interrupt
7 period values and said resource requirement values.

1 22. An article comprising: a storage medium having stored thereon instructions that, when
2 executed, result in a computing system having the capability to:
3 initialize interrupt period values;
4 generate virtualized interrupts by virtualizing hardware interrupts;
5 filter non-period interrupts;
6 reject aperiodic interrupts; and
7 adjust said interrupt period values iteratively until substantially equivalent to actual
8 interrupt periods.

1 23. The article of claim 22, wherein said instructions, when executed, further result in the
2 capability to:
3 acquire resource requirement values; and
4 schedule a plurality of virtual machines (VMs) to achieve real-time deadlines based, at
5 least in part, on said interrupt period values and resource requirement values.

1 24. The article of claim 23, wherein said resource requirement values are acquired from said
2 plurality of VMs.

1 25. The article of claim 22, wherein said instructions, when executed, result in said
2 computing platform having the further capability to:
3 determine resource requirement values, wherein determining said resource requirement
4 values comprises:
5 initializing said resource requirement values; and
6 adjusting said resource requirement values iteratively based, at least in part, on a
7 determination of an occurrence of a respective predetermined instruction.

1 26. The article of claim 25, wherein adjusting said resource requirement values comprises:
2 increasing said resource requirement values if said respective predetermined instruction
3 does not occur;
4 decreasing said resource requirement values if said respective predetermined instruction
5 occurs prior to a target time; and
6 scheduling a plurality of virtual machines (VMs) based, at least in part, on said interrupt
7 period values and said resource requirement values.

1 27. A system comprising:
2 a computing platform;
3 said computing platform being adapted to implement, at least, a virtual machine monitor
4 (VMM) and a plurality of virtual machines (VMs);
5 said VMM being capable of scheduling said VMs to execute real-time applications
6 based, at least in part, on a resource requirement (X_i) for each VM and an interrupt period (Y_i)
7 for each VM.

1 28. The system of claim 27, further comprising:
2 an interface capable of communicating respective X_i and Y_i values for said each VM to
3 said VMM.

1 29. The system of claim 27, wherein said VMM comprises:
2 a feedback loop capable of determining a respective X_i for said each VM;
3 a hardware interrupt virtualizer capable communicating device interrupts to said plurality
4 of VMs and filtering non-periodic interrupts;
5 an interrupt period detector (IPD) capable of determining said periods for periodic
6 interrupts and communicating said periods to a scheduler; and
7 said scheduler being capable of said scheduling of said plurality of VMs.

1 30. The system of claim 29, wherein said feedback loop comprises:
2 a detector capable of determining whether each of said VMs issues a predetermined
3 instruction and indicating said determinations to a proportional integral derivative (PID)
4 controller;
5 said PID being capable of adjusting said respective X_i for said each VM based, at least
6 in part, on said determination and communicating said adjusted respective X_i to said scheduler.